

IN THE CLAIMS:

1 1. (Original) A stress measuring method characterized by comprising
2 an electron beam irradiating process that irradiates an electron beam on a
3 specimen,
4 a spectroscopy process that analyses light generated from the specimen by the
5 above-mentioned electron beam irradiating process and obtains a spectrum, and
6 a stress calculating process that obtains a stress change based on a spectrum shift
7 between a spectrum obtained from the specimen in a predetermined state and a spectrum
8 obtained from the specimen in a state different from the predetermined state.

1 2. (Original) The stress measuring method described in claim 1 and characterized
2 by that a residual stress is obtained in the above-mentioned stress calculating process based on a
3 spectrum shift between a specimen spectrum as being a spectrum in a state that no stress exists in
4 the specimen and a stress impressed spectrum as being a spectrum in a state that a residual stress
5 exists in the specimen.

1 3. (Currently Amended) The stress measuring method described in claim 1-~~or~~2, and
2 characterized by that
3 an external force impressing process that applies an external force to the specimen
4 prior to the above-mentioned electron beam irradiating process is further provided, and
5 an internal stress is obtained in the above-mentioned stress calculating process
6 based on a spectrum shift between an internal stress impressed spectrum as being a spectrum in a
7 state that an internal stress is generated in the specimen by the external force impressing process
8 and a specimen spectrum as being a spectrum in a state no stress exists in the specimen or a

9 stress impressed spectrum as being a spectrum in a state that a residual stress exists in the
10 specimen.

1 4. (Original) The stress measuring method described in either one of claim 1
2 through claim 3, and characterized by that

3 the above-mentioned electron beam irradiating process includes a broad area
4 electron beam irradiating process that irradiates an electron beam without narrowing down on a
5 broad area that is broad enough compared with a spot size of the electron beam that is narrowed
6 down to obtain a requested space resolution, and

7 in the stress calculating process a spectrum obtained by analyzing light generated
8 from the specimen by the broad area electron beam irradiating process is made to be a specimen
9 spectrum as being a spectrum in a state that no stress exists in the specimen.

1 5. (Original) The stress measuring method described in either one of claim 1
2 through claim 3, and characterized by that

3 the above-mentioned electron beam irradiating process includes a broad area
4 electron beam irradiating process that irradiates an electron beam on a broad area that is broad
5 enough compared with a spot size of the electron beam that is narrowed down to obtain a
6 requested space resolution with scanning the spot size, and

7 in the stress calculating process an average of spectra of light generated by
8 irradiating each electron beam in the broad area electron beam irradiating process is made to be
9 the specimen spectrum as being the spectrum in the state that no stress exists in the specimen.

1 6. (Currently Amended) The stress measuring method described in claim 4 or
2 ~~claim 5~~, wherein the above-mentioned broad area is all the entire area of the specimen.

1 7. (Currently Amended) The stress measuring method described in claim 4 ~~or~~
2 ~~claim 5~~, wherein a diameter of the above-mentioned broad area is set as not less than 100 times
3 of the spot size of the electron beam that is narrowed down so as to obtain the required space
4 resolution.

1 8. (Currently Amended) The stress measuring method described in ~~either one of~~
2 ~~claim 1 through claim 3~~, and characterized by that
3 a minute amount sample obtaining process that obtains a minute amount of a
4 sample from the specimen is further included, and
5 in the stress calculating process a spectrum of light obtained by irradiating an
6 electron beam on the minute amount sample is made to be a specimen spectrum as being a
7 spectrum in a state that no stress exists in the specimen.

1 9. (Currently Amended) The stress measuring method described in ~~either one of~~
2 ~~claim 1 through claim 8~~, and characterized by that
3 a composition analyzing process that analyzes a partial difference of composition
4 of the specimen is further included, and
5 in the above-mentioned stress calculating process the above-mentioned specimen
6 spectrum is determined for each area where composition of the specimen differs obtained by the
7 above-mentioned composition analyzing process in consideration of a spectrum shift generated
8 due to the difference of composition.

1 10. (Currently Amended) The stress measuring method described in ~~either one of~~
2 claim 1 ~~through claim 9~~, wherein

3 external light whose spectrum is known is irradiated in the above-mentioned
4 electron beam irradiating process,

5 a spectrum of the external light and a spectrum of light emission from the
6 specimen are obtained in the above-mentioned spectroscopy process, and

7 each position of spectra from the specimen in each state to be compared in order
8 to measure a stress change is compensated based on the spectrum of the external light in the
9 above-mentioned stress calculating process.

1 11. (Original) The stress measuring method described in claim 10, and characterized
2 by that a position of a spectrum of a specimen spectrum as being the spectrum in the state that no
3 stress exists in the specimen and a position of a spectrum of the stress impressed spectrum as
4 being a spectrum in a state that a residual stress exists in the specimen are compensated
5 respectively based on a spectrum of external light in the above-mentioned stress calculating
6 process.

1 12. (Currently Amended) The stress measuring method described in claim 10 ~~or~~
2 ~~claim 11~~, and characterized by that a position of a spectrum of an internal stress impressed
3 spectrum as being a spectrum in a state that an internal stress exists in the specimen and a
4 position of a spectrum of a specimen spectrum as being a spectrum in a state that no stress exists
5 in the specimen or a position of a spectrum of the stress impressed spectrum as being a spectrum
6 in a state that a residual stress exists in the specimen are compensated respectively based on a
7 spectrum of external light in the above-mentioned stress calculating process.

1 13. (Currently Amended) The stress measuring method described in claim 10 ~~or~~
2 ~~claim 11~~, wherein a predetermined peak wavelength as being a reference for the above-
3 mentioned external light spectrum is set near a predetermined peak wavelength for the light
4 emission spectrum from the specimen.

1 14. (Currently Amended) The stress measuring method described in ~~either one of~~
2 ~~claim 1 through claim 13~~, and characterized by that a correlation calculating process that
3 calculates a correlation between an amount of external force impressed on the specimen and an
4 amount of the above-mentioned spectrum shift is included prior to the above-mentioned stress
5 calculating process.

1 15. (Currently Amended) The stress measuring method described in ~~either one of~~
2 ~~claim 1 through claim 14~~, and characterized by that the above-mentioned specimen includes at
3 least one kind of an element selected from a family consisting of lanthanoid by an amount within
4 a range of 1 ppm ~ 10000 ppm.

1 16. (Original) The stress measuring method described in claim 15, and characterized
2 by that the above-mentioned lanthanoid is at least one element selected from a family consisting
3 of Sm, Eu, Tb, ~~Y~~, Yb, La, Er, and Gd.

1 17. (Currently Amended) A stress measuring device characterized by comprising
2 an electron beam irradiating ~~means~~ unit that irradiates an electron beam on a
3 specimen,
4 a spectroscopy ~~means~~ unit that analyzes light generated from the specimen by the
5 electron beam irradiating ~~means~~ unit so as to obtain a spectrum, and

6 a stress calculating ~~means~~ unit that obtains a stress change generated in the
7 specimen based on a spectrum shift between a spectrum obtained from the specimen in a
8 predetermined state and a spectrum obtained from the specimen in a state different from the
9 predetermined state.

1 18. (Currently Amended) The stress measuring device described in claim 17, and
2 characterized by the above-mentioned stress calculating ~~means~~ unit is to obtain a residual stress
3 based on a spectrum shift between a specimen spectrum as being a spectrum in a state that no
4 stress exists in the specimen and a stress impressed spectrum as being a spectrum in a state that a
5 residual stress exists in the specimen.

1 19. (Currently Amended) The stress measuring device described in claim 17 ~~or claim~~
2 ~~18,~~ and characterized by that an external force impressing ~~means~~ unit that applies an external
3 force to the specimen is further provided.

1 20. (Currently Amended) The stress measuring device described in claim 19, and
2 characterized by that the above-mentioned stress calculating ~~means~~ unit is to obtain an internal
3 stress from a spectrum shift between an internal stress impressed spectrum in a state that the
4 internal stress is generated in the specimen by the external stress impressing ~~means~~ unit and the
5 above-mentioned specimen spectrum or the above-mentioned stress impressed spectrum.

1 21. (Currently Amended) The stress measuring device described in ~~either one of~~
2 claim 17 ~~through claim 20,~~ and characterized by that a minute amount sample obtaining ~~means~~
3 unit that obtains a minute amount of sample from the spectrum is further provided.

1 22. (Currently Amended) The stress measuring device described in ~~either one of~~
2 claim 17 ~~through claim 21, and~~ characterized by that a composition analyzing ~~means~~ unit that
3 analyses a partial difference of composition of the specimen is further provided.

1 23. (Currently Amended) The stress measuring device described in ~~either one of~~
2 claim 17 ~~through claim 22, and~~ characterized by that an external light irradiating ~~means~~ unit that
3 irradiates external light whose spectrum is known is further provided.

1 24. (Currently Amended) The stress measuring device described in ~~either one of~~
2 claim 17 ~~through claim 23, and~~ characterized by that a visualizing ~~means~~ unit that visualizes a
3 portion to be measured of the above-mentioned specimen is further provided.

1 25. (Currently Amended) The stress measuring device described in ~~either one of~~
2 claim 17 ~~through claim 24, and~~ characterized by that a diameter of a beam spot of an electron
3 beam irradiated by the above-mentioned electron beam irradiating ~~means~~ unit is not more than
4 100 nm.

1 26. (Currently Amended) The stress measuring device described in ~~either one of~~
2 claim 17 ~~through claim 25, and~~ characterized by that the above-mentioned electron beam
3 irradiating ~~means~~ unit is a scanning electron microscope.

1 27. (Currently Amended) A stress measuring device characterized by comprising
2 a light irradiating process unit that irradiates irradiating light on a specimen,
3 a spectroscopy process unit that analyzes light generated from the spectrum by the
4 above-mentioned light irradiating process so as to obtain a spectrum, and

5 a stress calculating process unit that obtains a stress change generated in the
6 specimen based on a spectrum shift between a spectrum obtained from the specimen in a
7 predetermined state and a spectrum obtained from the specimen in a state different from the
8 predetermined state, wherein

9 the light irradiating process unit includes a broad area light irradiating process that
10 irradiates irradiating light without narrowing down the irradiating light on a broad area that is
11 broad enough compared with a spot size of the irradiating light that is narrowed down to obtain a
12 requested space resolution, and

13 in the above-mentioned stress calculating process unit a spectrum obtained by
14 analyzing light generated from the specimen by the broad area light irradiating process is made
15 to be a specimen spectrum as being a spectrum in a state that no stress exists in the specimen.

1 28. (Currently Amended) The stress measuring device characterized by comprising
2 a light irradiating process unit that irradiates irradiating light on a specimen,
3 a spectroscopy process unit that analyzes light generated from the spectrum by the
4 above-mentioned light irradiating process unit so as to obtain a spectrum, and

5 a stress calculating process unit that obtains a stress change generated in the
6 specimen based on a spectrum shift between a spectrum obtained from the specimen in a
7 predetermined state and a spectrum obtained from the specimen in a state different from the
8 predetermined state, wherein

9 the above-mentioned light irradiating process unit includes a broad area light
10 irradiating process that irradiates irradiating light on a broad area that is broad enough compared

11 with a spot size of the irradiating light that is narrowed down to obtain a requested space
12 resolution with scanning the spot size, and
13 in the above-mentioned stress calculating process unit an average of spectra of
14 light generated by irradiating each irradiating light in the broad area light irradiating process is
15 made to be a specimen spectrum as being a spectrum in a state that no stress exists in the
16 specimen.

1 29. (New) A method of measuring stress comprising:
2 providing a specimen to be measured;
3 irradiating the specimen with an electron beam;
4 measuring the radiation from the specimen after contact with the electron beams;
5 and
6 calculating the stress based upon a spectrum shift between a first spectrum of a
7 predetermined reference state and a second spectrum measured at a predetermined measurement
8 position on the specimen.

1 30. (New) The method of Claim 29 wherein the first spectrum of the predetermined
2 reference state is determined by averaging a plurality of measurements across the specimen to
3 approximate a stress-free state for the specimen.

1 31. (New) The method of Claim 30 wherein the plurality of measurements represents
2 an area of the specimen which is approximately 100 times as large or larger than the
3 predetermined measurement position.

1 32. (New) The method of Claim 29 wherein the predetermined reference state is
2 determined by measuring the first spectrum while exerting a stress force on the specimen of a
3 predetermined value and the second spectrum at the predetermined measurement position is
4 measured without exerting the stress force.

1 33. (New) The method of Claim 32 wherein the stress force is applied mechanically
2 to the specimen.

1 34. (New) The method of Claim 32 wherein the stress force is applied thermally to
2 the specimen.

1 35. (New) The method of Claim 32 wherein the predetermined reference state is
2 measured over a plurality of different stress forces to correlate the amount of external force and
3 the corresponding spectrum shift.

1 36. (New) The method of Claim 29 further including preparing the specimen to be
2 measured by including within the specimen a predetermined material that can be activated by the
3 electron beam to emitting radiation.

1 37. (New) The method of Claim 35 wherein the predetermined material includes at
2 least one element from a lanthanoid series of elements.

1 38. (New) The method of Claim 36 wherein the ratio of the lanthanoid to the
2 specimen is within a range of 1 ppm to approximately 10000 ppm.

1 39. (New) The method of Claim 29 further including determining the composition of
2 the specimen and adjusting the calculate stress on the basis of the determined composition
3 relative to a predetermined composition standard for the specimen.

1 40. (New) The method of Claim 29 further including controlling the temperature of
2 the specimen during the measurement steps to a predetermined temperature.

1 41. (New) The method of Claim 29 further including irradiating the specimen with a
2 predetermined light radiation and measuring the radiation from the specimen after contact with
3 the light radiation to provide a peak reference for compensation of the electron beam calculated
4 stress.

1 42. (New) The method of Claim 29 wherein the predetermined measurement position
2 is irradiated by an electron beam having a diameter of 10 nm or less.

1 43. (New) The method of Claim 29 further including measuring the residual stress in
2 the specimen by measuring at least a portion of the specimen in a state without any residual
3 stress and calculating peak shifts of the first and second spectrums.

1 44. (New) A system for measuring stress in a specimen with an electron beam
2 comprising:

3 a irradiating unit for providing an electron beam to irradiate the specimen;

4 a measuring unit for providing measurement signals of the radiation from the
5 specimen after contact with the electron beams; and

6 a calculating unit for calculating the stress from the measurement signals by
7 determining a spectrum shift between a first spectrum of a predetermined reference state and a
8 second spectrum measured at a predetermined measurement position on the specimen.

1 45. (New) The system of Claim 44 wherein the first spectrum of the predetermined
2 reference state is determined by the calculating unit by averaging a plurality of measurements
3 across the specimen to approximate a stress-free state for the specimen.

1 46. (New) The system of Claim 45 wherein the irradiating unit directs the electron
2 beam to enable a plurality of measurements representative of an area of the specimen which is
3 approximately 100 times as large or larger than the predetermined measurement position.

1 47. (New) The system of Claim 44 further including a stress force applying unit
2 wherein the predetermined reference state is determined by measuring the first spectrum while
3 exerting a stress force on the specimen of a predetermined value and the second spectrum at the
4 predetermined measurement position is measured without exerting the stress force.

1 48. (New) The system of Claim 47 wherein the stress force is applied mechanically
2 to the specimen.

1 49. (New) The system of Claim 47 wherein the stress force is applied thermally to
2 the specimen.

1 50. (New) The system of Claim 47 wherein the predetermined reference state is
2 measured over a plurality of different stress forces to correlate the amount of external force and
3 the corresponding spectrum shift.

1 51. (New) The system of Claim 44 further including a doping unit for preparing the
2 specimen to be measured by including within the specimen a predetermined material that can be
3 activated by the electron beam to emitting radiation.

1 52. (New) The system of Claim 51 wherein the predetermined material includes at
2 least one element from a lanthanoid series of elements.

1 53. (New) The system of Claim 52 wherein the ratio of the lanthanoid element to the
2 specimen is within a range of 1 ppm to approximately 10000 ppm.

1 54. (New) The system of Claim 44 further including a composition analyzing unit for
2 determining the composition of the specimen and adjusting the calculate stress on the basis of the
3 determined composition relative to a predetermined composition standard for the specimen.

1 55. (New) The system of Claim 44 further including a temperature control unit for
2 controlling the temperature of the specimen during the measurement to a predetermined
3 temperature.

1 56. (New) The system of Claim 44 further including a light radiating unit for
2 illuminating the specimen with light and a light measuring unit for measuring radiation from the
3 specimen after contact with the light radiation to provide a peak reference for compensation of
4 the electron beam calculated stress.

1 57. (New) The system of Claim 44 wherein the predetermined measurement position
2 is irradiated by an electron beam having a diameter of 10 nm or less from the irradiating unit.